

ones, and what is wanted now is a voyage of, at the very least, the duration and scope of that of the *Challenger*. It is also true that all the recent expeditions have been foreign, and that Great Britain has, ever since 1872, lagged behind in this respect. It is owing to our present condition of naval superiority and commercial progress that we should do our share in oceanographical research.

In many ways the outlook is now markedly different from what it was in 1872, and so much more evident is the need for renewed investigation. The detailed study of the results obtained by the *Challenger* herself, and the discussion which these have now received, point to the need for renewed investigation, both on more intensive and more extensive scales. It cannot be said that the recent expeditions afford data for the settlement of most questions. One must never forget what a very insignificant fraction of the whole area of the ocean bottom has been touched by *all* the deep-sea expeditions. There is an enormous tract, said Mr. Tate Regan at the British Association discussion, lying round the Falkland Islands and up as far as Montevideo, which is almost unknown. All this lies within the 100-fathom contour line, and it may be the region of lucrative fisheries. Yet over it all there are only some eight trawling records—two by the *Challenger* and six by the *Albatross*. In these days, when trawler-owners are seeking new grounds, when the British fishery industry looks like being world-wide in its scope, and when steam fishing-vessels can cross the ocean and can fish commercially at depths of 100 to 200 fathoms, such a suggestion cannot be ignored.

All such investigations carried out with the object of discovering fishing-grounds, charting unknown sea-bottoms, or investigating tides and currents from the point of view of the navigator are, of course, utilitarian. But they employ scientific methods and they obtain a great surplus of data to be worked out from a purely scientific point of view. We have not the space here to advert to the enormous importance and theoretical interest of a study of the ocean from the point of view of meteorology. Nor can we insist, as we ought to do, on the reflex value of an arousal of popular interest in marine science. Immersed, as we are at present, in the problems of commerce and industrial production, one is apt to forget how curious are all people connected with the sea in the results of marine research. That popular curiosity and interest is something that scientific organisation ought legitimately to attempt to satisfy.

NO. 2656, VOL. 106]

Philosophical Aspects of Nature.

- (1) *The Concept of Nature: Tarner Lectures delivered in Trinity College, November, 1919.* By Prof. A. N. Whitehead. Pp. ix + 202. (Cambridge: At the University Press, 1920.) Price 14s. net.
- (2) *Lectures on Modern Idealism.* By Josiah Royce. Pp. xii + 266. (New Haven: Yale University Press; London: Humphrey Milford; Oxford University Press, 1919.) Price 12s. 6d. net.

IT may seem that in bringing together two such widely divergent views and methods as those represented by the present professor of pure mathematics in the Imperial College of Science and Technology, and by the late genial and kindly Harvard professor and leader of modern idealism, the problem with which each of these courses of lectures deals is in danger of being prejudged. Prof. Whitehead's method is severely practical, that of Royce speculative and theoretical. It is, however, in contrasts that the profounder meaning of antithetical theories is revealed. These two courses of lectures—very similar in form and in aim—separated in time by an interval of thirteen years, both deal with the same subject, the concept of Nature, and both are conscious, despite a fundamental divergence, of an identical problem.

(1) The Tarner Lectures of Prof. Whitehead consist of a core of constructive work. Certain kinds of entities are posited for knowledge in sense-awareness. The classification of these, and the investigation of the sorts of relations they can have to one another, form the constructive work undertaken. The most fundamental of these entities are events, and the first kind of relation examined is time. The factors in Nature represented by the conception of space are next brought under review, and the method by which they are analysed is named "extensive abstraction." Space and motion are then considered, and lead to the formulation of a theory of congruence—that is, of measurement in space and time. This plunges us into the relativity controversy, and enables the author to define his position in regard to the theory of Einstein. Finally, we have a theory of "objects," which are described as "the elements in Nature which do not pass." Objects are "recognised," events happen; an event occurs once and is unique, but objects have the character that they can "be again." This core of constructive work has a prologue and an epilogue in the two introductory and the two concluding chapters. It is in these that the problem underlying the concept of Nature is acknowledged, the principle which must rule scientific inquiry discussed, and the issue between the divergent

methods, the *a priori* and the experimental, decided.

Prof. Whitehead sees very clearly and expresses very boldly the philosophical problem of Nature. It is admirably expounded in his chapter on "Theories of the Bifurcation of Nature." By bifurcation he means that Nature is presented first in sense-awareness and then in a conceptual activity of thought. Though the two consequent forms, sense-images and concepts, are inseparable, they are so absolutely distinct that when we reflect on them they present themselves as two totally different kinds, or orders, of facts, between which the relation, so far from being obvious and transparent, is literally incomprehensible. For not only is our sense-awareness fragmentary, requiring an activity of conception to complete it—as when, for example, we conceive another side of the moon—but also the fragmentary appearances themselves are referred to another kind of reality, conceived as existing in itself and called Nature. Physical science treats of electrons, æther waves, and such like, as existent entities, sense-awareness being a special form of the relation of these to the mind. This old philosophical problem has recently forced itself on the attention of physicists by reason of the startling nature of Einstein's special and general relativity principle. In fact, Einstein may truly be said, adapting the famous phrase of Kant, to have roused physicists from their dogmatic slumber. Prof. Whitehead treads the new ground confidently, but yet with caution. He will not have the "curvature of space," and he insists that the concept of Nature shall concern the reality of the observation, unconfused with any question concerning its relation to the observer and his system. To deny the possibility of this detachment is in his view not simple scientific scepticism, but destruction of the basis on which any physical science can be constructed.

(2) The lectures of the late Prof. Royce, originally entitled "Aspects of Post-Kantian Idealism," were first delivered in 1906, and therefore antecede the apparition of the Principle of Relativity. This is not very important, because that principle propounded nothing in the least strange and unfamiliar to philosophers. It is, indeed, essentially one and identical with the principle of idealism. It is its confirmation by experiments which has brought it home with such force to the scientific worker. Although, therefore, the lectures are largely historical, and deal with a philosophical movement and speculation a century old, they are vitally relevant to our present problem. The problem of post-Kantian idealism was essentially the problem of Nature, in particular the fact that while Nature is a concept brought to birth by the

mind itself in its intellectual activity, under the stimulus and out of the material provided for it by sense-awareness, yet this concept stands before the mind as necessarily independent and alien in its existence, and as the ground of the existence of the mind itself.

It is curious how, in the historical retrospect of the important philosophical movement which followed Kant, Hegel overshadows all his contemporaries. One of the most interesting portions of this book is the account of the wonderfully brilliant work of Schelling, especially in his early period. No physicist has grappled the problem of Nature with greater zeal or with keener insight than this philosopher.

It is not our purpose to pass judgment, but we commend these two books—both remarkable for their lucidity and intellectual honesty—to all who wish to have a comprehensive grasp of the physical and metaphysical problem of the concept of Nature.

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The Vehicles of Hereditary Qualities.

The Physical Basis of Heredity. By Prof. T. H. Morgan. (Monographs on Experimental Biology.) Pp. 305. (Philadelphia and London: J. B. Lippincott Co., 1919.) Price 10s. 6d. net.

SO far as the study of heredity means formulating and explaining the resemblances and differences between successive generations great progress has certainly been made, and Prof. Morgan thinks it is mock modesty to refrain from saying that many problems have been solved. The present book is a masterly account of recent work on the physical basis of inheritance, which means, for practical purposes, the chromosomes of the germ-cells. The general evidence in support of the chromosomal theory is once more discussed; its fundamental propositions are clearly stated and abundantly illustrated; and numerous recent subtleties, at varying levels of probability, are explained. The book is indispensable to serious students of biology.

The first general principle is Mendel's law of segregation. The fertilised ovum contains paired factors or genes, causally linked with certain characters; these come into relation to each other, but separate off cleanly in the germ-cells of the offspring, one member of each pair going to one daughter-cell, the other member to the other cell. It is during maturation that the conjugation of homologous (paternal and maternal) chromosomes occurs and is followed by their subsequent segregation. In all probability, apart from hybrids altogether, the germ-plasm of each immature